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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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In the Matter of	)	
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Amendment of the Commission's Rules	)	RM-9165
to Incorporate Mobile Earth Station	)	
Out-of-Band Emission Limits	)	

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FEDERAL COMMUNICATIONS COMMISSION
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COMMENTS OF AMSC SUBSIDIARY CORPORATION

Bruce D. Jacobs
Stephen J. Berman
Colette M. Capretz
Fisher Wayland Cooper Leader
& Zaragoza L.L.P.
2001 Pennsylvania Avenue, N.W.
Suite 400
Washington, D.C. 20006
(202) 659-3494

Lon C. Levin
Vice President
and Regulatory Counsel
AMSC Subsidiary Corporation
10802 Parkridge Boulevard
Reston, Virginia 22091
(703) 758-6000

December 8, 1997

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Summary

AMSC opposes the proposed restrictions on out-of-band emissions by MSS terminals. All of AMSC's terminals meet the proposed limits for protecting GPS and most meet the proposed limits for protecting Glonass, but as many as 30,000-40,000 voice terminals may not meet the proposed limits for protecting Glonass. Thus, if the Commission adopts the proposed limits, AMSC would face an exposure of several million dollars for the redesign of its voice terminals before 2002 and as much as $80 million or more for the replacement of these terminals in 2005.

The proposed restrictions are irrational as long as they are limited to MSS terminals. There are many other known sources of interference in the GNSS bands which must be addressed at the same time if there is to be any rational decision regarding protection of GNSS from out-of-band emissions. AMSC's research, presented here, indicates that there are millions of VHF radios which may produce out-of-band emissions in the GNSS bands hundreds of times more powerful than the levels NTIA proposes as the limit for MSS terminals.

The aviation industry should assume most of the burden of any new limits, since the new navigation systems are intended for the benefit of that industry, primarily by permitting it to operate more efficiently. The proposed limits are based on an analysis that refuses to require the aviation industry to use the kinds of reasonable, available receiver and antenna design that would mitigate out-of-band emissions.

There is too much uncertainty concerning Glonass to establish any limits for its protection at this time. No limits should be imposed to protect Glonass receivers unless and until there is a definite schedule for integrating Glonass into the FAA's aeronautical navigation system, including specific appropriations for that effort.

The limits proposed by NTIA are based on the aviation industry analysis, rather than one conducted by MSS interests. The MSS analysis demonstrates that a set of limits that is acceptable to AMSC and others would be more than sufficient to protect aeronautical navigation. That analysis indicates that the worst case -- an MSS terminal causing the kind of interference that would require an aircraft to make two approaches instead of one -- is likely to occur in less than two approaches out of ten trillion in which the aircraft uses GPS or Glonass for navigation.

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COMMENTS OF AMSC SUBSIDIARY CORPORATION

AMSC Subsidiary Corporation ("AMSC")[1/] hereby submits its comments in opposition to the proposal of the National Telecommunications and Information Administration ("NTIA") for strict new limits on the out-of-band emissions of Mobile Satellite Service ("MSS") terminals operating in the 1610-1660.5 MHz band.[2/] NTIA proposes the new limits, which permit less than 1/5000th the out-of-band emission level permitted by the current limits, in order to protect from interference future aeronautical radionavigation systems that rely on the Global Positioning System ("GPS") and the Global Orbiting Navigation Satellite System ("Glonass"). Together,

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1/ AMSC is the entity authorized by the Commission in 1989 to construct, launch and operate the first dedicated U.S. MSS system. Memorandum Opinion, Order and Authorization, 4 FCC Rcd 6041 (1989); Final Decision on Remand, 7 FCC Rcd 266 (1992); *aff'd sub nom.* Aeronautical Radio, Inc. v. FCC, 983, F.2d 275 (D.C. Cir. 1993). Since then, the company has spent more than $600 million to develop and deploy the facilities needed to provide nationwide mobile service via satellite. The first AMSC satellite was launched in 1995, and AMSC began offering its SKYCELL Satellite Telephone Service in early 1996. Today, AMSC provides a full range of land, maritime, and aeronautical mobile satellite services, including voice and data and a unique multipoint dispatch service, throughout the contiguous United States, Alaska, Hawaii, the U.S. Virgin Islands, and coastal areas up to 200 miles offshore. These services are available to areas of the country too remote to be served by terrestrial systems.

2/ Letter to Regina M. Keeney, Chief, International Bureau, from Richard D. Parlow, Associate Administrator, Spectrum Management, National Telecommunications and Information Administration (September 18, 1997). On October 23, 1997, the Commission issued an order extending the deadline for comments on this proposal to December 8, 1997. Order, RM-9165, DA- No. 2254 (October 23, 1997).

GPS and Glonass are part of what is referred to as the Global Navigation Satellite System ("GNSS"), which the international aviation industry seeks to use to improve airline and airport efficiency. Of particular relevance to AMSC, NTIA proposes to require all newly-commissioned MSS terminals to meet the strict new limits beginning in 2002 and to replace by 2005 all terminals that do not meet the proposed limits.

The record establishes several key flaws in the NTIA proposal:

- The proposal ignores other sources of interference, including millions of two-way radios in the VHF band, that are permitted to emit at levels that greatly exceed what NTIA proposes for MSS terminals.

- The proposal puts the entire burden of protecting aeronautical radionavigation systems on the MSS industry, ignoring steps that the aviation industry could take to reduce the need for such strict limits.

- The proposal is based on protecting use of the Glonass system from interference despite the absence of any budgeted plans by the Federal Aviation Administration ("FAA") to integrate Glonass into its future aeronautical navigation plans.

- The proposal ignores a rigorous analysis by the MSS industry demonstrating that the likelihood of any MSS terminal causing interference to the use of Glonass is no more than two in ten trillion approaches.

AMSC is not opposed to taking reasonable steps to accommodate legitimate needs of the aviation industry. Many of its current generation terminals already meet all the proposed limits, and it appears that all AMSC terminals meet the proposed limit for protecting GPS from interference. As many as thirty or forty thousands of its voice terminals, however, that have been or will be manufactured to the current FCC limits may not meet the proposed limits for protection of Glonass from interference. If the proposed limits are adopted, AMSC will need to modify the current design of this equipment; in addition, AMSC will face a liability of $60-80 million to replace those terminals that remain in use at the end of 2004, which is little more than six years away and well before the end of the terminals' likely operational life.

AMSC urges the Commission not to force it to absorb such an enormous and unnecessary liability. Instead, the Commission should establish a rational rulemaking process that will look at all major potential sources of interference to radionavigation systems, insist that the aviation industry share in any costs that are imposed to establish the necessary protection, and create reasonable standards and timetables for protecting such systems.

Background

The Global Navigation Satellite System. GNSS is a concept for a new satellite-based system of aeronautical navigation. In the United States, GNSS will rely initially (beginning no earlier than 2001) and for the foreseeable future on the U.S. GPS system, a constellation of 24 low-Earth orbit satellites that transmit signals centered at 1575.42 MHz, supplemented by a constellation of geostationary satellites referred to as the Wide Area Augmentation System ("WAAS").[3/] The GPS system is maintained by the Defense Department, which has used it extensively for a number of years. Efforts by the FAA to develop use of GPS for aeronautical radionavigation began in the late 1980's.

The Russian Glonass system, which is expected to operate at 1597-1605 MHz after 2005, is roughly equivalent in design to the U.S. GPS system, but its development and integration into GNSS in the U.S. and elsewhere are far less certain.[4/] Use of Glonass is supported by certain foreign aviation administrations that resist relying on a system that is controlled by the U.S. Defense Department. The future of Glonass, however, is clouded by questionable economic and

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3/ *See, generally*, FAA's Plan for Transition to GPS-Based Navigation and Landing Guidance ("GPS Plan").

4/ "Assessment of Radio Frequency Interference Relevant to the GNSS," RTCA, Inc., SC-159, RTCA Document No. RTCA/DO-235, Appendix E - MSS Perspective ("MSS Appendix") at E-35-38, dated January 27, 1997 ("RTCA Report"). The MSS Appendix is attached at Exhibit A.

political support for the system in Russia. Poor maintenance of facilities and lax procedures have led to operational problems, and such difficulties are likely to persist in the absence of additional support. The development of Glonass has also been plagued by numerous technical problems. As a result, in the U.S., Glonass will probably never be used as an exclusive source of flight navigation capability. To the extent that Glonass is used domestically for GNSS, it is likely to serve only as a supplement to GPS.

Before Glonass can be used even as a GPS supplement for precision approaches, there are numerous government, technical, and business milestones that must be accomplished. These include: (i) budget appropriations; (ii) development of Minimum Operational Performance Standards ("MOPS") for Glonass equipment, followed by the design, development, testing, and type certification of the avionics for each aircraft type; (iii) manufacture, installation, and certification of the equipment on each aircraft as it is brought in for major scheduled maintenance; (iv) FAA implementation of the required air traffic control procedures; training of crews on the proper use of the Glonass equipment; (v) modification of WAAS to permit its operation in conjunction with Glonass, and contracts for these upgrades; and (vi) an end-to-end system certification program by the FAA to assure that all parts of the system meet the requirements for use on precision approaches. The experience with GPS indicates that this implementation is likely to take more than a decade. The deployment of GPS/WAAS for use during precision approaches will have taken at least that long if it is completed on schedule in 2001, and Glonass presents additional problems. Given their administrative and technical difficulties, it is likely to take the Russians a substantial period to bring Glonass up to a point of readiness such that it complies with the stringent availability and integrity requirements imposed on GPS. In addition, installation of Glonass equipment onto aircraft is likely to be relatively slow, with aircraft owners and operators having just invested in GPS systems and, in so doing, obtaining most of the benefits of GNSS. Installation of Glonass throughout an entire fleet is likely to take at least four to six years, as the commercial airlines install new avionics only when aircraft are already out of service for major scheduled maintenance actions. GPS Plan at 4-4.

The FAA does not yet have any budgeted plans for integrating Glonass into GNSS in the United States. The FAA makes no mention of Glonass in its annual aviation development plans.[5/]

The airline industry expects this improved navigational capability to permit more direct flight routing that will shorten flying times and save fuel, and reduce delays and increase airport and airplane utilization by permitting more bad-weather landings, and the FAA believes that use of GNSS will allow the retirement of costly, maintenance-intensive ground-based systems. GPS Plan at 1-1. At issue in this proceeding is the possibility that an MSS terminal will cause interference to aircraft using Glonass signals for navigation during what is called a "Category I" approach.[6/] Category I approaches are those in which the flight crew lacks visibility at some point between 200 feet and approximately 500 feet. At an altitude of 200 feet during an approach, an aircraft is still at least a half-mile away from the end of the runway. Weather

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5/ 1997 FAA Plan for Research, Engineering & Development, Chapter 3, Communications, Navigation Surveillance, Satellite Navigation Program #032-110.

6/ No one disputes that MSS terminals on the ground operating at current out-of-band emission levels are too far from aeronautical receivers to possibly cause interference to GNSS when it is used for en route navigation, rather than approaches.

The analysis that led to NTIA's proposal considered only the aviation industry's use of GNSS for Category I approaches. The analysis assumes that any use of GNSS for Category II and III approaches, involving operations at altitudes below 200 feet, will be based on the protection criteria adopted for GNSS use in Category I approaches. RTCA Report at 3.

conditions producing Category I conditions are relatively rare at almost all U.S. airports, apparently existing less than five percent of the time overall.

During any approach, including a Category I approach, an aircraft operates with some predetermined margin for error. The flight crew attempts to follow the optimum flight path, but any flight path within a predetermined "containment region" is considered safe. During a Category I approach, when visibility is poor, the flight crew will rely on GNSS positional and velocity readouts to guide the aircraft along this flight path until better visibility is achieved. An aircraft's GNSS sensor analyzes data for a given block of time, averaging it in order to estimate the current position of the aircraft. MSS Appendix at E-14.

An interruption in the transmission of data from the system's satellites to the aircraft's GNSS receiver will not render the GNSS readouts immediately unreliable. This is due in part to the fact that large aircraft are physically incapable of varying their flight path substantially in a few seconds. Following an interruption, a GNSS sensor retains enough data about the aircraft's recent flight path to continue estimating the aircraft's current position with the required accuracy. The FAA has determined that a GNSS sensor can function for at least five seconds without additional incoming positional data before creating an unacceptable probability that the aircraft has moved outside of its containment region. For this reason, the FAA's procedures provide for an alarm to sound in the cockpit five seconds after a GNSS failure, unless the integrity of the navigation data is restored within the five-second period.[7/]

If an alarm is triggered, the flight crew stops relying on GNSS. At that point, if the aircraft has descended to an area of good visibility (no less than 200 feet), the flight crew may

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7/ "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment," RTCA, Inc., RTCA Document No. RTCA/DO-229, dated January 16, 1996, at Section 2.1.4.10.

conclude its approach and proceed to the landing phase. The aircraft will still be within its containment region and more than half a mile away from the airport runway. In the worst case, the crew would, at an altitude of at least 200 feet, execute a standard procedure for a "missed approach." To do so, the flight crew ascends toward a predetermined airspace clear of traffic. Typically, the aircraft then circles back to begin a second approach.

Potential interference to Glonass receivers. NTIA's proposal, which seeks to curtail potential interference to GNSS, has focused on MSS terminals in the adjacent 1610-1660.5 MHz bands. It is widely understood, however, that there are many other sources of potential interference to GNSS receivers that may lawfully emit substantially higher levels of spurious products in the GNSS band.[8/] For example, there are literally many millions of fixed, portable, and mobile two-way commercial and marine radios in active use in this country.[9/] Fleets of taxicabs, buses, delivery vans and trucks, public-safety vehicles, and commercial and recreational watercraft use these devices routinely, often in the vicinity of airport runways. Based on their rugged, solid-state construction, such two-way radios remain in service for decades.

Current FCC rules permit such products to radiate up to several thousand times more spurious energy on GNSS frequencies than are proposed by NTIA for MSS terminals. For example, Section 90.209(c) allows a two-way VHF radio to produce -43 dBW of signal power on any given frequency in the GNSS bands. This FCC limit is substantially more lax -- a full 37 dB

8/ RTCA Report at iii. The RTCA report identifies but does not address a solution for a variety of potential sources of radio frequency interference, including land mobile VHF/UHF radios, on-board and ground-based aeronautical VHF radios, commercial broadcast radio and television transmitters, amateur radio receivers, military radars, and unlicensed equipment.

9/ The potential for interference from these land mobile VHF radios is discussed in the RTCA Report in Section 8.2, at 29.

(5000 times) more liberal -- than NTIA's proposed narrowband limit. Using the aviation industry's own prediction model, a VHF radio radiating in the GNSS band at the level permitted by Part 90 (-43 dBW) would cause interference even if it were half a mile away from an airplane equipped with a GNSS receiver.

AMSC's recently conducted a cursory sampling of test data submitted to the FCC in type-acceptance applications for common VHF two-way radios. *See* Exhibit B. That sampling confirms that VHF radios do generate harmonics and other spurious components in the GNSS bands at levels substantially in excess of the limits NTIA proposes for MSS terminals. In a few hours of research, AMSC uncovered at least four Part 90 transmitters produced in the past five years by mainstream manufacturers (Midland and Kenwood) that, according to test data submitted to the FCC, produced spurious emissions in the GNSS bands that range from -65.4 to -59.2 dBW.

The Commission does not keep test data more than five years, so there is no practical way to determine the extent to which equipment type-accepted more than five years ago would or would not comply with the proposed standard. Moreover, because applicants are not required to provide data for out-of-band emissions that are more than 20 dB better than the permitted level, there is likely to be Part 90 equipment manufactured even in the past five years that produces out-of-band emissions in the GNSS band in excess of the proposed limits, but not at levels that required disclosure to the Commission as part of the type-acceptance process. Thus, in addition to those for which data exists, there is a vast population of Part 90 radios for which no data exists but which must be assumed not to comply with the proposed limits.

With respect to emissions from MSS terminals, in 1994, the FCC, NTIA, and FAA directed the Radio Technical Committee on Aeronautics ("RTCA") to work towards a consensus standard for MSS terminal out-of-band emissions into the GNSS band.[10] Representatives of the aviation industry and MSS system licensees met over a nearly three-year period and issued a lengthy report.[11] On the issue of the necessary out-of-band emission limits, however, there was no consensus. Instead, the report contains two separate analyses reaching two different conclusions.[12] The limits proposed by aviation interests are those adopted by NTIA in its proposal to the Commission. The analysis of the MSS interests, attached hereto as Exhibit A, demonstrates that, under its own standard of -54 dBW/MHz/-64 dBW, the probability of interference to Glonass operations due to out-of-band emissions by MSS terminals during a Category I approach is less than two in ten trillion Category I approaches. MSS Appendix at E-29. Moreover, the MSS Appendix demonstrates that any interference would be transient (no more than one to two seconds) and would at worst lead to a missed approach. *Id.* at E-5, E-14.

The MSS Appendix estimates that an MSS terminal will be transmitting close enough to a GNSS receiver to potentially cause interference to GNSS no more than 155 seconds during a 24-hour period, even assuming the existence of 2 million MSS terminals.[13] The chance of such a

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[10] Memorandum of Understanding Between The Federal Communications Commission, National Telecommunications and Information Administration, and The Federal Aviation Administration, (November 18, 1994).

[11] RTCA Report. The following MSS companies participated in this process: AMSC, Comsat Mobile Communications, Globalstar, Inmarsat, Iridium, Loral Qualcomm Satellite Services, Motorola, and Odyssey/TRW.

[12] MSS Appendix; RTCA Report, Appendix F - Aviation Perspective.

[13] MSS Appendix at E-29. This estimate is based on the following: (a) the percentage of vehicles in the U.S. equipped with MSS terminals, estimated to be 2 million; (b) the number of vehicles within the threat radius of an aircraft, conservatively estimated to be one hundred at any one time; (c) the probability that a terminal is active (.015); (d) the probability that a call is made via satellite (0.1); and (e) the probability that the MET user is voice activating the transmitter during the period of maximum interference coupling

(continued...)

terminal causing disruption during that 155 seconds would be approximately one in ten billion cases.[14] In light of the probabilities calculated above, the overall probability of a Glonass failure during a Category I precision approach is estimated to be less than two in ten trillion approaches. *Id.* at E-29. The FAA projects 200 million aircraft operations per year in the U.S. by 2007, which means that even if all those operations were to involve Category I approaches, MSS terminals operating at the level proposed by the MSS Appendix might cause a loss of lock, possibly resulting in a missed approach, at most, once every 2500 years. *Id.*

The MSS Appendix incorporates a number of assumptions that the aviation industry resists. These include the assumption that Glonass receivers will use current technology and antenna design to reduce susceptibility to interference. *Id.* at E-4-5. The MSS Appendix also uses what it considers to be a conservative, realistic separation distance between aircraft during Category I approaches and MSS terminals of 150 feet based on a study of actual terrain conditions, and an elevation mask for Glonass signals of 15 degrees or more for Category I precision approaches. *Id.* at E-5. Finally, while aviation interests assume the effect of MSS

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[13](...continued)
(0.6). The last two factors do not apply to AMSC terminals. Thus, using an estimated thirty thousand AMSC terminals, the probability of a terminal transmitting near any airport in the United States in the range in which it might cause interference to an aircraft's use of Glonass is 38 seconds during a 24-hour period.

[14] *Id.* at E-28-29. As explained in the MSS Appendix, whether or not a cycle slip occurs is a function of the following variables: (a) received field strength of the Glonass satellite signal at the aircraft; (b) the amount of antenna gain for the Glonass signal at the Glonass receiver; (c) the received field strength of the out-of-band emission from the MSS terminal at the Glonass receiver; (d) the amount of antenna gain at the Glonass receiver for the out-of-band emission from the MSS MET; and (e) the level of sensitivity of the GNSS receiver. The probability of cycle slipping provides a conservative measure for the effect of MSS terminal out-of-band emissions on Glonass performance. *Id.*

emissions is unlimited in time, the MSS Appendix recognizes the transient nature of any aircraft exposure, on average less than a second and two seconds at most. *Id.*

The effect of implementing NTIA's proposed specifications. The existing Commission requirements for AMSC's terminals limit out-of-band emissions in the Glonass band to -55 dBW/4 kHz or -31 dBW/MHz. Sections 25.202(f). All of AMSC's first-generation terminals meet this standard with substantial margin. As to the proposed NTIA limits, based on testing by manufacturers to date, all of AMSC's data terminals meet the limits for protection of both GPS and Glonass. In addition, all of AMSC's terminals, both voice and data, appear to meet the proposed limits for protection of GPS. Some of AMSC's first-generation voice terminals, however, which are produced by two manufacturers, Westinghouse Electric Corporation and Mitsubishi Electric Corporation, may not meet the proposed limits for 1597-1605 MHz, in which Glonass operates. Design work on these terminals began in 1991, before there was any reason to be concerned with protection of Glonass, and production began in 1995, well before the RTCA had concluded its efforts. Testing that has been done on a small sample of these terminals by at least one of the manufacturers indicates that all of the tested terminals meet the proposed limits, even in the Glonass band. However, the sample was not sufficiently large to be considered statistically significant to permit the manufacturer to guarantee that all production units will meet the proposed limits. (The manufacturer states that there can be a variation of 6 dB over temperature and production tolerances, and therefore a larger number of units must be sampled.)

AMSC has explored the possibility of being able to test each terminal as it is produced to determine if it exceeds the existing limits sufficiently to meet the proposed new limits. It appears, however, that such testing to detect extremely low levels of energy, under proper conditions (including wide temperature variations) would be extremely expensive. Similarly, it is not practical to retrofit all existing terminals with new filters that would further reduce their out-of-band emissions.[15/]

AMSC also has explored the option of incorporating the new out-of-band emission limit into the next generation of voice terminals that AMSC intends to introduce, beginning perhaps as early as 1999. Indications from the existing manufacturers are that meeting the proposed new limits would increase the cost of the terminals by over $100 per unit and that the modified diplexer that is required would add significantly to each unit's size and weight.

AMSC estimates that, before these new terminals can be introduced, the manufacturers will have produced as many as thirty to forty thousand units, some of which may exceed the limits proposed by NTIA in the Glonass band. This includes terminals that have already been installed, terminals that have already been manufactured but have not yet been installed, and terminals that will be manufactured prior to the production of second-generation units.

AMSC's conversations with its customers indicate that many expect to use the existing equipment for as long as it works. Several trucking fleets, for instance, have indicated that they intend to remove the terminals from truck cabs when the cabs are replaced and re-install the same equipment in the replacement cabs. AMSC expects that many of these terminals will be in use

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15/ The design of AMSC's terminals makes modification or replacement of the internal output diplexer impractical. As a result, external filtering would be required to reduce emissions. On one type of unit, in which the existing diplexer is internal, there is only one radio frequency connection to the unit, and the loss imposed by the external filter would affect the receive performance of the unit as well as the transmit performance. The filter would have an estimated insertion loss of about 1.0 dB. Compensating for that loss on the forward link would result in a 25% loss in system capacity. It would not be possible to increase the output power to compensate for the loss, and therefore there would be a loss of margin affecting return link coverage and performance. The physical difficulties are even greater for the other type of units, since the RF electronics are integrated into the antenna unit, making it virtually impossible to install an extra filter due to space constraints.

beyond 2005. (AMSC's second-generation space segment, which it anticipates launching before 2005, will be backwards-compatible, to permit continued use of existing equipment.)

There also would be a clear problem in the marketing of any yet unsold first-generation terminals. In order to eliminate risk to its potential customers, AMSC is likely to have to guarantee a replacement terminal, at a cost to AMSC of at least $1000-2000 per terminal to any potential customer that expects to use its terminals beyond 2005. (In order to maintain its goodwill, AMSC is also likely to have to make the same offer to existing customers whose terminals might need to be replaced by 2005.) If a large percentage of AMSC's first-generation voice terminals remain in use in late 2004, this would require AMSC to spend as much as $80 million or more at that time.

Discussion

The out-of-band emission limits that NTIA proposes are extremely onerous, requiring a reduction to a level that is so low that it takes sophisticated testing equipment to even determine whether an individual terminal complies with the standard. The cost of developing and implementing new terminal designs is enormous, particularly for a relatively new company such as AMSC, which has already invested hundreds of millions of dollars into the development of its U.S. domestic MSS system. Nonetheless, AMSC is prepared to participate in any reasonable effort to protect the use of important new technology by the aviation industry.

The problem is that the NTIA proposal, as it stands, is not reasonable. *First*, it represents a piecemeal approach that fails completely to account for other, much more significant sources of potential interference. Perhaps the most significant of these other sources of potential interference is the millions of two-way VHF radios that routinely transmit in the GNSS band near airports at power levels that are permitted to be several hundred times higher than what

NTIA proposes for MSS terminals. *Second*, the NTIA proposal fails to ask the aviation industry to do its fair share to mitigate the potential for interference to GNSS aeronautical receivers. The receivers can easily be made more robust and the GNSS system itself can be made more fault-tolerant. *Third*, any requirement for phasing out terminals that are not compliant with the protection standard for Glonass must be pushed back to no earlier than 2010, since this is clearly the earliest possible implementation date for integrating Glonass into GNSS. *Fourth*, before the Commission can adopt any new standards, it must thoroughly consider the merits of the MSS analysis of interference potential, developed as part of the RTCA process. That analysis demonstrates that a far more attainable standard for out-of-band emissions is more than sufficient to protect GNSS.

I. Any attempt to protect GNSS from interference must consider all potential sources of interference, including many that are more problematic than MSS terminals.

As discussed above, there are many other potential sources of interference to GNSS signals that are permitted to operate at levels that exceed those proposed by NTIA for MSS terminals. Moreover, AMSC's examination of actual measured data produced by manufacturers as part of the type acceptance process for VHF two-way radios indicates that many such radios in fact generate harmonics in the GNSS band at permitted levels that substantially exceed those proposed by NTIA. These radios exist in far greater numbers than MSS terminals and are far more prevalent in the vicinity of airports. The same is likely to be the case with other potential sources of interference.

Under these circumstances, the FCC should not even consider imposing unique requirements on MSS terminals. Instead, it must first conduct a comprehensive rulemaking that examines all potential sources of interference. Without such a comprehensive approach, any rules that are adopted will be incapable of accomplishing their stated goal, the protection of GNSS.

The Administrative Procedure Act requires the Commission's actions, findings, and conclusions to be rational, rather than arbitrary and capricious. 5 U.S.C. §706(2)(A). An agency must examine the relevant data and articulate a satisfactory explanation for its action including a "rational connection between the facts found and the choice made." *Burlington Truck Lines, Inc. v. United States*, 83 S.Ct. 239, 245-246 (1962). The Supreme Court has stated that an agency rule normally would be arbitrary and capricious if, among other factors, the agency has "failed to consider an important aspect of the problem." *Motor Vehicle Mfrs. Ass'n v. State Farm Mut.*, 103 S.Ct. 2856, 2867 (1983). In this case, the Commission's imposition of increased restrictions on MSS out-of-band emissions, without considering the more severe problem of interference caused by such other sources as VHF radios, would constitute a failure to consider an important aspect of any problem and could not possibly yield an effective solution.

Any regulations adopted by the Commission must also treat similarly situated entities in a similar manner. *Melody Music, Inc. v. FCC*, 345 F. 2d 730, 732-733 (D.C. Cir. 1965); *McElroy Elec. Corp.*, 990 F.2d 1351, 1365 (D.C. Cir. 1993). The NTIA proposal is silent on the issue of why it would impose a uniquely stringent requirement on only one potential source of interference to GNSS, a burden which is particularly unfair in light of the relatively minor impact of MSS terminals. In this case, the record contains no basis for subjecting MSS services to new out-of-band emissions restrictions without imposing similar or greater restrictions on the other emitters that are more likely to cause interference to GNSS.

II. The aviation industry should be required to take additional steps to protect GNSS

Before any new requirements are imposed on MSS terminals, the Commission should require the aviation industry, which will be the beneficiary of GNSS, to take all reasonable steps to protect GNSS. This should include optimizing the GNSS receivers and their antennas to minimize their susceptibility to out-of-band emissions from land mobile terminals.[16] It is also critical that the aviation industry address the eventual need for additional independent sources of navigation information, such as inertial measurement units, that many believe will be required before GNSS will be sufficiently fault-tolerant to be used in precision approaches and landings.[17] If the aviation industry is so convinced that GNSS is susceptible to one to two seconds of transient interference from an MSS terminal, then its real problem is that it has such a fault-intolerant system.

Ultimately, if the aviation industry remains convinced that all MSS terminals must meet the proposed limit by 2005, then the aviation industry should be required to pay for the costs that it imposes on the owners of those terminals. As discussed above, AMSC estimates that, in the case of terminals used on its system, the replacement cost of these terminals could be more than $80 million. The Commission should act here as it has in other recent rule makings, where it has required service providers benefitting from new regulations to compensate other licensees for the replacement or retrofitting of equipment rendered unusable by those rules.[18]

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[16] For instance, the MSS Appendix estimates that the incorporation of vector loop tracking in GNSS receivers would reduce the susceptibility to interference by 7 to 10 dB, decreasing the need for new emission limits on MSS terminals. MSS Appendix at E-18.

[17] RTCA Report, Section 10.3.1, at 41.

[18] *See, e.g.*, Redevelopment of Spectrum to Encourage Innovation in the Use of New Telecommunications Technologies, First Report and Order, 7 FCC Rcd 6886, 6890

(continued...)

III. No rules should be established for protection of Glonass unless and until it is certain that Glonass will be integrated into a domestic GNSS system

As described above, the integration of Glonass into a U.S. domestic GNSS is highly speculative and has no specific schedule. AMSC does not deny that there is interest in using Glonass particularly among foreign aviation administrations, but to the best of AMSC's knowledge, Congress has yet to budget any money for such a process. Moreover, even after such a commitment is made, it will take more than a decade to complete the integration process. Standards must be set, the necessary equipment must be designed and manufactured, equipment must be installed and crews trained, and the overall system must be certified both internationally and by the FAA. Until the money is budgeted for this process and there is a realistic timetable for the total process, no substantial burdens should be imposed on others, such as AMSC and its customers, to protect Glonass from interference.

IV. The record demonstrates that GNSS can be protected without imposing such strict limits on out-of-band emissions

As discussed above, the MSS Appendix contains an extensive analysis, developed by MSS interests and attached hereto, of the probability of interference by an MSS terminal to a GNSS receiver during a Category I approach. That analysis demonstrates that the probability of such interference is too low to be consequential. Moreover, it is also demonstrated that, in the worst case situation, the consequence of such interference will be only the need to undertake a second approach. The Commission must address this analysis thoroughly in any consideration of NTIA's proposed limits.

[18/](...continued)
(1992) (requiring emerging technology providers requesting involuntary relocation of 2 GHz Fixed Microwave Services to guarantee payment of all relocation expenses and build the new microwave facilities at the relocation frequencies).

Conclusion

Therefore, based on the foregoing, AMSC respectfully urges the Commission to reject NTIA's proposed limits. The proposed limits do not bear a rational relationship to their stated goal of protecting the GNSS system, since they do not apply to other more numerous sources of potential interference. The proposed limits also are unduly burdensome and unnecessarily restrictive as they relate to the MSS industry. The Commission should undertake a more comprehensive review that considers all potential sources of interference, ensures that any proposed limits are based on a realistic schedule for implementation of Glonass into the GNSS, and ensures that the aviation industry shares in the burden of implementing any new standards that are adopted.

Respectfully submitted,

AMSC Subsidiary Corporation

Bruce D. Jacobs
Stephen J. Berman
Colette M. Capretz
Fisher Wayland Cooper
Leader & Zaragoza L.L.P.
2001 Pennsylvania Ave., N.W.
Suite 400
Washington, D.C. 20006
(202) 659-3494

Lon C. Levin
Vice President and Regulatory Counsel
AMSC Subsidiary Corporation
10802 Park Ridge Boulevard
Reston, Virginia 22091
(703) 758-6000

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EXHIBIT A

APPENDIX E
MSS PERSPECTIVE